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Thermoluminescence and isothermal annealing kinetics of the F-centres in X irradiated KCl and KCl:KNO_3

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In recent years several papers (Jain & Mahendra 1965, Partridge & May 1969) have been published for and against the view that direct correlation exists between F-centre bleaching and thermoluminescence in alkali halides, especially KCl, pure and doped This note, which reports the annealing characteristics of F centre in KCl and KCl : KNO_3 single crystals and the accompanying thermal glow, strikingly supports the view that no connection exists between the F-centre decay and thermoluminescence (Partridge & May 1969).

Single crystals of KCl and KCl doped with KNO_3 ($1\ 8 \times 10^{-2}$ mole; determined by infrared absorption technique (Wardzynski 1958)) were grown in our laboratory from analar BDH salts and then cleaved to proper size for optical absorption measurements with a Beckman DU spectrophotometer. Thermoluminescence of these samples were measured with the help of a photomultiplier and a quick response optical recorder described elsewhere (Mukherjee 1968). For the production of F-centres a Philips sealed X-ray tube (Cu-target) was employed.

The concentration of F-centres with the same dose of X-ray irradiation at 28°C (room temperature) are found to be higher for KCl : KNO_3 than that for pure KCl (Mukherjee & Bose 1966). When the doped crystal is irradiated and stored in the dark at room temperature the F-centre concentration decreases with time over a long period (~200 minutes). For the pure crystal there is very little decay of the centres with time and the concentration seems to attain a stable value within a few minutes. It has been further observed that room temperature bleaching of F-centres in pure KCl is accompanied by a detectable afterglow; in the case

of doped crystal no glow is found to occur. Therefore we conclude that the mechanism of room temperature anneal of F-centres in pure KCl and KCl : KNO_3 must be different.

Thermoluminescence of KCl and KCl : KNO_3 has been measured after X-ray irradiation at room temperature (figure 1a). The intensity of thermoluminescence of the doped sample is very poor compared to that of pure KCl, although the doped system contained larger number of *F*-centres. The doped crystal needed about four to five times higher dose of X-ray irradiation before any measureable thermal glow is obtained. The above results show that the decay kinetics of F-centres in KCl and KCl : KNO_3 are entirely different also at temperatures higher

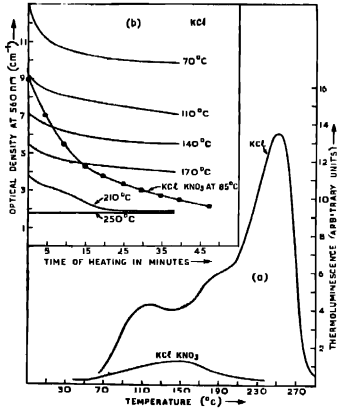

Figure 1(a) Thermoluminescence of KCl and KCl : KNO_3 irradiated at room temperature with 30 kV, 10 mA X-rays (KCl is exposed for 15 min, KCl : KNO_3 for 60 min. The rate of heating is 60°C/min).

(b) Decrease in optical density/cm at 560 nm with time of annealing at temperatures indicated in the figure. The F-centres have been produced by X-rays at room temperature prior to annealing.

than that of room and that the total number of centres destroyed does not determine the integrated intensity of thermoluminescence (Partridge & May 1969, Sonder *et al* 1967).

Isothermal anneals of the F-centres in X-ray irradiated KCl have been studied at several temperatures. The same piece of KCl after X-ray colouration at room temperature is kept at different temperatures indicated in figure 1b. The absorption is measured at room temperature after the sample is kept at the stipulated temperature for a specified time and quenched. The results show that

F-centre concentration in X-irradiated pure KCl attains a stable value at all temperatures within a period of about 40 minutes, whereas the bleaching of the same centres in KCl : KNO_3 never ceases if the sample is coloured at room temperature and then kept at 85°C (figure 1b) In other words complete bleaching of F centres occurs even at 85°C for KCl · KNO_3; similar state occurs at about 210°C for KCl. It is interesting to note that for pure KCl the highest temperature glow peak is the most intense one, but the number of F-centres destroyed in this region is very small. This only indicates that no connection exists between F-centre decay and thermoluminescence (Partridge & May 1969).

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Electronic property of photosensitive film formed during the corrosion of copper and α-brass in chlorine water

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Plate—2

In the corrosion of copper in sea water in sunlight Korovin & Ulanovskii (1971) have reported the formation of CuCl film but they have not mentioned the photosensitive character of the film, nor image formation on the film.

In the present investigation an attempt has been made to confirm the photosensitive character of the film formed on copper and brass. Measurement of photocurrent against time has been used to correlate the time of image appearance and also to suggest the mechanism for the same.

Electrolytic copper as well as 63/37 brass specimens were washed, dried and polished according to the method suggested by Champion (1952). A mirror